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A PROBLEM OF INLAND NAVIGATION IN ROMAN GAUL[1]

The general topography of the waterways of Gaul was in certain respects eminently suitable to the development of inland navigation. Not only do most of the principal rivers of the country take their rise in the same general central region and flow thence outwards, in various directions, to the seas that bathe the coasts, but some of them in sections of their upper courses run roughly parallel and not very far apart, yet in opposite directions, with topographical conditions that favored in ancient days the transfer of cargoes by vehicle or pack-animal across the intervening country. There is no doubt of the great commercial and strategic importance under the Roman Empire of these natural routes, formed mainly of navigable rivers that traversed the country in various directions. Attention may be called e. g. (1) to the Rhone, which formed, in combination with the Loire, a route from the Mediterranean northward, then northwestward, and, finally, westward to the Atlantic Ocean, (2) to the Rhone, the Saône, and the Seine, which led to the English Channel, (3) to (a) the Rhone, the Saône, the Moselle, and the Rhine, and (b) the Rhone, the Saône, the Doubs, and the Rhine, which formed double lines of communication from the southern coast to the North Sea.

Strabo alludes to this fortunate hydrographic situation in two significant passages, 4. 1. 2, and 4. 1. 14. I give them in the version by Horace L. Jones (The Loeb Classical Library, 1923: see 2. 167, 209, 211):

Now the whole of this country is watered by rivers: some of them flow down from the Alps, the others from the Cemmenus and the Pyrenees; and some of them are discharged into the ocean, the others into Our Sea. Further, the districts through which they flow are plains, for the most part, and hilly lands with navigable water-courses. The river-beds are by nature so well situated with reference to one another that there is transportation from either sea into the other; for the cargoes are transported only a short distance by land, with an easy transit through plains, but most of the way they are carried on the rivers—on some into the interior, on the others to the sea. The Rhodanus offers an advantage in this regard; for not only is it a stream of many tributaries, as has been stated, but it also connects with Our Sea, which is better than the outer sea, and traverses a country which is the most favoured of all in that part of the world....

Tolosa is situated on the narrowest part of the isthmus which separates the ocean from the sea that is at Narbo, which isthmus, according to Poseidonius is less than three thousand stadia in width. But it is above all worth while to note again a characteristic of this region which I have spoken of before—the harmonious arrangement of the country with reference, not only to the rivers, but also to the sea, alike both the outer sea and the inner; for one might find, if he set his thoughts upon the matter, that this is not the least factor in the excellence of the regions—I mean the fact that the necessities of life are with ease interchanged by every one with every one else and that the advantages which have arisen therefrom are common to all; but especially so at present, when being at leisure from the weapons of war, the people are tilling the country diligently, and are devising for themselves modes of life that are civil. Therefore, in the cases of this sort, one might believe that there is confirmatory evidence for the workings of Providence, since the regions are laid out, not in a fortuitous way, but as though in accordance with some calculated plan. In the first place, the voyage which the Rhodanus affords inland is a considerable one, even for vessels of great burden, and reaches numerous parts of the country, on account of the fact that the rivers which fall into it are navigable, and in their turns receive most of the traffic. Secondly, the Rhodanus is succeeded by the Arar, and by the Dubis (which empties into the Arar); then the traffic goes by land as far as the Sequana River; and thence it begins its voyage down to the ocean, and to the Lexobii and Caleti; and from these peoples it is less than a day's run to Britain. But since the Rhodanus is swift and difficult to sail up, some of the traffic from here preferably goes by land on the wagons, that is, all the traffic that is conveyed to the Arvernians and the Liger River—albeit in a part of its course the Rhodanus draws close to these also; still, the fact that the road is level and not long (about eight hundred stadia) is an inducement not to use the voyage upstream, since it is easier to go by land; from here, however, the road is naturally succeeded by the Liger; and it flows from the Cemmenus Mountain to the ocean. Thirdly, from Narbo traffic goes inland for a short distance by the Atax River, and then a greater distance by land to the Garumna River; and this latter distance is about eight hundred or seven hundred stadia. And the Garumna, too, flows to the ocean....

From the latter of these passages of Strabo it appears that the Rhone and the Saône formed the main trunk line of inland navigation, with branches represented by the Loire, the Seine, the Moselle, the Doubs, the Rhine, and other rivers. So great was the importance of the Rhone as a waterway, even before the Roman conquest of all Gaul, that Marius paralleled by a canal its course through the delta forming the estuary, in order that boats might be able to avoid the difficulties of navigating the mouths of the river, difficulties caused by silting and by the shifting of the channels. This celebrated canal was called, after the name of its founder, Fossae Marianae. The only other artificial waterway known to have existed under Roman rule within the boundaries of modern France was a short one inside the present limits of Lyons, connecting the Saône and the Rhone a short distance above their confluence[1a].

There is every reason for believing that the greatest commercial activity developed on the rivers of Eastern

[1]This paper was read at the Twenty-Fifth Annual Meeting of The Classical Association of the Atlantic States, held at the Central High School, Philadelphia, May 5–6, 1932.

[1a]See Camille Jullian, Histoire de la Gaule, 5.130–131 (Paris, Hachette, 1920), and L. Bonnard, La Navigation Interieure de la Gaule à l'Epoque Romaine (Paris, 1913). M. Bonnard's work is a doctoral dissertation.

Gaul, especially the Rhone and the streams that formed with it almost continuous waterways from the Mediterranean to the North Sea. Literary references, inscriptions, and several noteworthy monuments with pictorial bas-reliefs representing boats and other elements of navigation equipment testify to the importance of the Moselle[2].

Ausonius, in his well-known poem, Mosella, devoted entirely to this river, describes the animated scene which it presented with its waters dotted with boats of different kinds, some propelled by oars, others towed from the banks. The river wound between hills of picturesquely varied appearance, hills covered with woods, grain fields, and vineyards. There were attractive villas along the banks. An important part of the traffic consisted of the product of the celebrated Moselle vineyards.

Divodurum (Metz), situated at the point where the highway from Rheims to Strasbourg crossed the Moselle, rose to such importance as a center of river traffic that it had its corporation of boatmen, Nautae Mosallici, as is shown by Corpus Inscriptionum Latinarum 13.4335:

M PUBLICIO SECun
DANO NAVTARVm
MOSALLICOR LIBERt
TABULARIO i IIII i Viro
AUGUSTALI

This inscription may be translated thus: 'To Marcus Publicius Secundanus, freedman of the boatmen of the Moselle, scribe, Sevir Augustalis'.

The Colonia Augusta Treverorum (Trier) was likewise a center of great commercial importance. This was due in part, no doubt, to its position near the confluence of the Sarre (Saravus, or Sara) and the Moselle (Mosella). Ausonius (Ordo Urbium Nobilium, 33–34, in the edition by Rudolph Piper, page 146 [Leipzig, Teubner, 1886]), speaks of this city as receiving merchandise from all parts of the earth:

largus tranquillo praelabitur amne Mosella,
longinqua omnigenae vectans commercia terrae.

Nature herself seemed to suggest that the channels of the Rhone, the Saône, the Moselle, and the Rhine should be made to form a single waterway from the Mediterranean to the North Sea. The only interruption in such an all-water route was the elevated region called to-day Les Monts Faucilles, between the upper course of the Moselle and the headwaters of the Saône. This upland region presents a sharp declivity on the side of the Moselle valley on the northeast, but descends gently to the basin of the Saône on the southwest.

An enterprising Legatus Augusti under Nero proposed to overcome this obstacle to continuous inland navigation between the two seas by opening a canal across it.

Our authority for this proposal is Tacitus, Annales 13. 53:

Quietae ad id tempus res in Germania fuerant, ingenio ducum, qui pervulgatis triumphi insignibus maius ex eo decus sperabant, si pacem continuavissent. Paulinus Pompeius et L. Vetus ea tempestate exercitui praeerant. Ne tamen segnem militem attinerent, ille inchoatum ante tres et sexaginta annos a Druso aggerem coercendo Rheno absolvit, Vetus Mosellam atque Ararim facta inter utrumque fossa conectere parabat, ut copiae per mare, deinde Rhodano et Arare subvectae, per eam fossam, mox fluvio Mosella in Rhenum, exim Oceanum decurrerent, sublatisque itineris difficultatibus navigabilia inter se Occidentis Septentrionisque litora fierent. Invidit operi Aelius Gracilis, Belgicae legatus, deterrendo Veterem, ne legiones alienae provinciae inferret studiaque Galliarum affectaret, formidolosum id imperatori dictitans, quo plerumque prohibentur conatus honesti.

For this I offer the following version:

'Affairs in Germany had been quiet down to this time through the disposition of the commanders, who, because of the prodigality with which triumphal honors had been bestowed, looked for greater distinction from preserving peace. The commanders of the army at this time were Paulinus Pompeius and Lucius Vetus. Not wishing, however, to keep their troops idle, the former completed the dike for restraining the Rhine which was begun by Drusus sixty-three years before, and Vetus was preparing to connect the Rivers Saône and Moselle by a canal, so that merchandise coming by sea, after ascending the Rhone and the Saône, would pass through this channel and then descend the Moselle into the Rhine and pass on into the Ocean, and thus the western and the northern coasts would become internavigable. But Aelius Gracilis, Legatus of Gallia Belgica, frustrated the undertaking by dissuading Vetus from introducing the legions into another governor's province, and thus tampering with the passions of the Gauls; he insisted that it would be dangerous to the Emperor, an argument by which many worthy enterprises are stopped'.

After speaking of events elsewhere down to 58 A. D., Tacitus returns in this chapter to the affairs of the German provinces which he had left at the close of Annales 12.28, in 50 A. D. What is narrated in the above citation from Annales 13.53 must have occurred in 55 A. D. That it cannot have occurred later is shown by the reference in the passage to the completion by Paulinus of the dike sixty-three years after it was begun by Drusus, who died in 9 B. C. It can hardly have been earlier than this date because Lucius Vetus must have been of consular rank when he held command in Germany as Legatus Augusti, and he is almost certainly the L. Antistius Vetus mentioned by Tacitus in Annals 13.11 as Nero's colleague in the consulship at the beginning of 55. He must, then, have gone to Germany in the same year, after having completed his term of office as consul. That Paulinus was Governor of Lower Germany and Lucius Vetus Governor of Upper Germany is evident from the situation, relative to these two provinces respectively, of the works which the two Legati Augusti had in mind. We know nothing further about Lucius Vetus. Paulinus Pompeius had been Consul Suffectus in some undeterminable year. He was father-in-law of Seneca the

[2]See Jullian, 5.161–163 (see note 1a, above), and particularly the famous Roman monument known as Igler Säule, at Igel, on the left bank of the Meuse, between Trier and Wasserbillig, with its interesting pictorial reliefs, one of which represents river boats laden with freight. The inscription, with important indications relative to the monument, is published in Corpus Inscriptionum Latinarum 13.4206. This and other material illustrating inland navigation in Gaul are to be found in E. Esperandieu, Receuil Général des Bas-Reliefs de la Gaule Romaine (ten volumes. Paris, Imprimerie Nationale, 1907–1928). Some of the more important reliefs for this subject are to be found in M. Rostovtzeff, The Social and Economic History of the Roman Empire, Plate XXX, opposite page 210 (Oxford: At the Clarendon Press, 1926).

philosopher, and is probably referred to, with an indication of the identity of his father, in a passage of Pliny, Naturalis Historia 33.143:

...Pompeium Paulinum, Arelatensis equitis Romani filium, paternaque gente pellitum, XII milia pondo argenti habuisse apud exercitum ferocissimis gentibus oppositum scimus....

Probably the Paulinus to whom Seneca dedicated his essay De Brevitate Vitae was the father of the Pompeius Paulinus now under discussion, and therefore the rich Roman knight of Arelate mentioned by Pliny the Elder. It appears, moreover, from De Brevitate Vitae 13.8, a passage regarding the *pomoerium* of Rome, that this essay of Seneca must have been written before the enlargement of the *pomoerium* under Claudius in 49 A. D., although probably in the same year. It appears also from 18.3 that Paulinus, to whom the work was dedicated, was at the time Praefectus Annonae.

The present discussion grew out of my curiosity as to the means by which the designer of this Saône-Moselle waterway proposed to carry the canal over the divide between the head of navigation on the Saône and the upper course of the Moselle.

I have carefully examined this region on the French military service contour maps and have found that, according to the physical conditions, the most practical canal route between the two rivers is obviously the one followed by the present artificial waterway, the Canal de l'Est, which leaves the Moselle about three kilometers below (north of) Epinal, at an altitude of 320.20 meters above sea level, rises in a distance of three kilometers, by means of fourteen locks, to the summit level of 361 meters, continues 13 kilometers at this level, and then descends in a distance of 50 kilometers by means of 46 locks to an altitude of 223.13 meters at its junction with the Saône. To state the situation more concisely, we may say that the modern canal ascends about 132 feet in two miles from the valley of the Moselle, runs about eight miles at this level, and then descends about 448 feet in 31 miles to the Saône. It is reasonable to suppose that, if the ancient designer actually plotted a canal route, he would have chosen this route, since any other course would have presented much greater difficulties.

The authorities generally believe that the Romans had no knowledge whatever of the now familiar device, the hydraulic lock, by means of which the difficulty arising from differences of level in artificial waterways is commonly overcome at the present time, and that this device was not invented until the fifteenth century[3].

If we assume that the idea of the hydraulic lock had not yet been conceived, or at any rate was unknown to Vetus when he proposed to connect the Saône and the Moselle by a canal, the question arises whether there were any other available means for overcoming the inequalities of profile in the new canal. One device is described by Pliny, Naturalis Historia 3.53, as applied on the Upper Tiber and two of its tributaries. Pliny's words are as follows:

Tiberis...tenuis primo nec nisi piscinis corrivatus emissusque navigabilis, sicuti Tinia et Clanis influentes in eum, novenorum ita conceptu dierum, si non adiu-

[3]By 'lock' we mean a watertight chamber introduced into a navigable channel at a point where it is necessary to effect a change in the surface level of the water. The chamber is enclosed at its opposite ends by gates, through the alternate opening and closing of which the water in the chamber is made to rise or to fall between the levels of the adjoining sections of the waterway, so that boats are raised or lowered. This device must be distinguished from the single gate or set of gates for impounding water which will be mentioned later. The Germans distinguish the two by using the term 'Kammerschleuse' for 'lock' in the sense given above to that term, and the term 'Stauschleuse' for the barrier maintained by a single gate or set of gates. Mr. A. P. Gest, in the volume entitled Engineering, in the series Our Debt to Greece and Rome (New York, Longmans, Green and Co., 1930), maintains that the lock was invented by the Egyptians, although it was not used elsewhere until the fifteenth century. Referring to the canal connecting the Nile and the Red Sea, Mr. Gest says (13):

"...The canal was finally completed by Ptolemy II, who, Strabo says, constructed locks with movable gates so that the boats could enter and leave the canal whenever they pleased; thus anticipating by about seventeen centuries the invention of lock gates for canals, usually attributed to Leonardo da Vinci..."

Mr. Gest, it may be noted, does not name the passage of Strabo that he had in mind.

Mr. Gest's statement that the Egyptians invented the lock (in the sense attached above to the term 'lock') is unlikely in itself and is unsupported by ancient literary evidence.

Consider first a passage in Strabo (17.1.25), relating to the canal between the Nile and the Red Sea, upon which, I am sure, Mr. Gest based his statement. The following is the translation of this passage given by Professor Horace L. Jones (The Geography of Strabo, The Loeb Classical Library, 8.77 [1932]):

"...The canal was first cut by Sesostris before the Trojan War—though some say by the son of Psammitichus, who only began the work and then died—and later by Dareius the First, who succeeded to the next work done upon it. But he, too, having been persuaded by a false notion, abandoned the work when it was already near completion; for he was persuaded that the Red Sea was higher than Aegypt, and that if the intervening isthmus were cut all the way through, Aegypt would be inundated by the sea. The Ptolemaic kings, however, cut through it and made the strait a closed passage, so that when they wished they could sail out without hindrance into the outer sea and sail in again..."

In connection with this passage, Professor Jones refers in his notes to the description of the same canal in Diodorus Siculus 1.33.8–12. We read, there this waterway connected the Pelusiac arm of the Nile with the Red Sea, and that it was finished by Ptolemy II. Special significance attaches to a statement in 1.33.11; "...At the most advantageous place he <Ptolemy II> built a cleverly contrived barrier. This he opened, whenever he wished to sail by, and quickly closed it again...."

Neither the expression 'closed strait', applied to this canal by Strabo 17.1.25 (**κλειστὸν ἐποίησαν τὸν εὔριπον**), nor the expression 'cleverly contrived barrier' used of it by Diodorus 1.33.11 (**τι φιλότεχνον διάφραγμα**) implies necessarily the existence of a lock, in the sense of a watertight chamber between gates or sluices, rather than a single gateway closed by a movable barrier. Furthermore, Diodorus's statement that the king 'quickly closed' the barrier as soon as he had sailed through is convincing evidence that there was no second barrier or gate to restrain the outpouring of the water from the higher level while the one barrier was open, and hence that there was only a single gateway, not a lock.

Someone may cite, as evidence for Mr. Gest's assertion, a later passage in Strabo (17.1.37), which refers to the canal between the Lake of Moeris and the Nile. Again I give the translation of Professor Jones (The Loeb Classical Library, 8.103):

"Be this as it may, the Lake of Moeris, on account of its size and its depth, is sufficient to bear the flood-tides at the risings of the Nile and not overflow into the inhabited and planted parts, and then, in the retirement of the river, to return the excess water to the river by the same canal at each of its two mouths and, both itself and the canal, to keep back an amount remaining that will be useful for irrigation. While these conditions are the work of nature, yet locks have been placed at both mouths of the canal, by which the engineers regulate both the inflow and the outflow of the water..."

I see no reason why the Greek expression here used by Strabo (**τῆς διώρυγος κλεῖθρα**) should be interpreted as applying to 'Kammerschleusen' rather than to 'Stauschleusen', even though Professor Jones, in his translation, uses the term "locks".

Since the purpose of the mechanism in question in this case was to regulate the flow of water between the Nile and the Lake of Moeris for irrigation purposes (not for navigation), single barriers at each mouth of the canal would obviously have sufficed. Locks, in the sense of double gateways with intervening chambers, would have been superfluous.

Not only do the passages cited offer no evidence for the existence of locks in ancient Egypt, but it seems unlikely that, if a discovery of such practical importance had been made there, it would have been entirely neglected in other parts of the Roman Empire, where no evidence of the existence of locks has been found. Teubert, a recognized authority on inland waterways (see note 3a, below) cites (1.32–33) very good evidence that the hydraulic lock was first employed by two Italian engineers, Organi and Fioravante, for connecting the famous canal of Lombardy, the Naviglio Grande, with the city moat of Milan, a junction which was effected in 1438–1439.

vent imbres. Sed Tiberis propter aspera et confragosa ne sic quidem praeterquam trabibus verius quam ratibus longe meabilis fertur....

This passage can be interpreted somewhat freely as follows:

'It <the Tiber> is at first small and navigable only by means of gates (sluices), by which the water is impounded and discharged, as is done also in the case of the Tinia and the Clanis, which flow into it; the water is collected for nine days, unless rains should help. But even then the Tiber, on account of its rugged and uneven channel, is really more suitable for navigation by rafts than by boats, for any great distance'.

From this account we gather that water was collected at certain places along the Tiber and the two tributaries mentioned, by means of dams or barrages, and was released at suitable intervals of time by means of sluices or gates, so that temporary freshets were created that carried the floating craft over the shoals. Such an arrangement could have been quite suitable on the Upper Tiber, where the direction of the traffic must have been almost wholly downstream, and, as Pliny tells us, the floating units were mostly rafts, which were probably broken up on their arrival at Rome, the material being disposed of as timber.

This method of facilitating inland navigation on waterways with descending channels has been resorted to on occasions in the Middle Ages and in modern times. Thus in the fourteenth century the citizens of Lübeck undertook to improve the River Stecknitz from its confluence with the Trave, near their city, southward in order to facilitate the transportation of salt. In 1342 they erected a barrage across the outlet of the Mollner See, where it empties into the Stecknitz. When by this means the water had been made to rise sufficiently in the lake, the gates in the barrage were opened and the salt-laden craft were carried down to Lübeck on the descending flood. Later, the waterway was continued southward from the Mollner See to the Delvenau River, and down the latter to Lauenburg on the Elbe[3a]. For this purpose it was necessary to make an artificial channel across the divide between the Mollner See and the Delvenau, but this was a water-parting of slight altitude. The waterway was provided with dams and gates functioning like those on the Upper Tiber described by Pliny the Elder. In this modern case the boats must have moved in both directions, but the ascents were very gradual. The entire waterway was 94 kilometers long, but the summit level was only seventeen meters above the Trave and twelve meters above the Elbe at Lauenburg. With the slight fall of water at the barrages it must have been possible to pull the craft, even when they were headed upstream, through the open gates against the outflowing current. The situation was in no sense parallel with that of a Saône-Moselle canal, which required a rise of 132 feet in two miles. Arrangements similar to those on the Stecknitz seem to have been installed in some of the French rivers in the Middle Ages, notably in the Yonne[3b]. But here too the fall was very gentle.

[3a]For the statements in this paragraph see Oskar Teubert, Die Binnenschiffahrt, 1.28 ff. (Leipzig, Englemann, 1912).

[3b]See Teubert (as cited in note 3a, above), 1.30.

The method of counteracting the difficulties of navigating rapid and shallow streams which was employed in antiquity on the Upper Tiber was applied to the Lehigh River in the early days of the anthracite mining industry in Pennsylvania. In 1819 the Lehigh Navigation Company built twelve dams in the section of the Lehigh from a point near Mauch Chunk to Easton, a distance of forty-seven miles, with a fall of approximately 388 feet. These constructions were provided with gates or sluices which were opened in succession when enough water had been collected to carry the craft on the artificial freshet from one pool to the next below. These barriers were called bear-trap dams, from the original device for raising the gates by hydraulic power for closing the sluiceways. In a short time the increased traffic on the Lehigh River required the substitution of locks and slack-water navigation, but, while the bear-trap dams were in use, there was an interesting analogy between the navigation of the Lehigh and that of the Upper Tiber in antiquity, for the movement of traffic on the Lehigh, even in the sections with least fall, was downstream only. It consisted of anthracite coal loaded in wooden box-like scows, called arks, sixteen to eighteen feet wide by twenty-five feet long, which floated down with the current. They reached Philadelphia by way of the Delaware River. At Philadelphia, after they had discharged their cargoes, they were scrapped, and the construction material was sold as timber[4].

Obviously, the navigation conditions on the Lehigh River as described above offer no counterpart to those of the proposed waterway between the Moselle and the Saône. That waterway would have had to cross a divide, and the traffic would necessarily have had to move upstream as well as down. I have in fact been unable to find any example of the use in ancient days of sluice-gates and temporary freshets that would even remotely suggest the feasibility of such a method of surmounting the difficulties of the ancient project.

It may be suggested that the author of the design for a waterway between the Moselle and the Saône intended that the small craft used at that time for river traffic, probably of not over ten or twelve tons burden, should be pulled up the steeper sections of the route on inclined planes.

It is known that in ancient times sea-going vessels that must have been much larger than these river-boats were hauled, on the *diolcos*, a sort of track, across the Isthmus of Corinth, a distance of about four miles, over a maximum altitude of about 260 feet[4a]. At places along the old Chinese waterways, moreover, boats were pulled on inclined planes with rollers by means of windlasses from lower to higher sections[4b]. A similar method is mentioned as in use in Flanders in the fourteenth century[4b]. A work by Vittorio Zonca, published in Italy in 1656, describes various methods of

[4]See Fred Brenckman, History of Carbon County, Pennsylvania, 79–81 (Harrisburg, Pennsylvania, James J. Nungesser, 1913).

[4a]See the article Isthmos, by Fimmen, in Pauly-Wissowa-Kroll, Real-Encyclopädie der Classischen Altertumswissenschaft, 9.2256–2265 (Stuttgart, Metzler, 1916): see especially columns 2258–2259. It appears that the Diolcos as well as the canal undertaken under Nero, but never completed, followed closely the line of the modern canal, which cuts through a maximum altitude of 79 meters.

[4b]See Teubert (as cited in note 3a, above), 1.32.

lifting boats on inclined planes with rollers or cradles fitted with small wheels. Allusion is made particularly to a device of this sort at Lizzafusina, at the mouth of the Brenta, near Venice, where the lifting power was supplied sometimes by the fall of the water, sometimes by animals[4b].

The Morris Canal in New Jersey, completed in 1831, connected Phillipsburg on the Delaware, opposite Easton, with Newark Bay. This waterway ascended 914 feet in a distance of fifty-one miles, from tidewater at Newark Bay to the summit level at Lake Hopatcong, and then descended 760 feet in about forty miles to the Delaware River at Phillipsburg. The steeper parts of the slopes were negotiated by means of twenty-three inclined planes, which were really canal-boat railways. Their usual ascent was about ten feet for every hundred feet of track. The average lift of the planes was sixty-three feet. The longest, at Boonton, had a rise of eighty feet. The canal-boats were of twenty-five tons capacity. The Pennsylvania State Canal between the Susquehanna and the Allegheny Rivers, completed in 1832, as the main part of a commercial artery westward across the State, was interrupted throughout the rugged section between Hollidaysburg on the Juniata River and Johnstown on the Conemaugh, a distance of 36.6 miles, where the boats, similar in size to those on the Morris Canal, were transported on cars on the Allegheny Portage Railway, which was finished in 1834. This railway ascended 1398 feet in 10.1 miles from Hollidaysburg to the summit of the Allegheny ridge, and then descended 1171 feet in 26.5 miles to Johnstown. The steeper parts of the ascents were covered by inclined planes, five on each side of the summit. These planes had double tracks and were operated by stationery engines; one car ascended while another descended. On one of the planes a rise of nearly 300 feet was effected in less than a mile.

A comparison of the situation of the probable route for the proposed waterway between the Moselle and the Saône under the Roman Empire with the situations mentioned above where inclined planes have been used does not preclude the possibility that the author of the ancient project in Gaul, which we are considering, intended to use planes for surmounting the more marked differences of level along his route. He may, in other words, have proposed to connect successive level stretches of his canal by means of inclined planes. It was probably not beyond the capacity of the engineers or mechanicians of the time to devise simple machines with windlasses by which the comparatively small river craft could be drawn up on rollers or wheeled cradles, compensating of course by slowness of movement for lack of modern forms of power.

I am, however, inclined to take the words of Tacitus (Annales 13.53) literally and to infer that the scheme called for an uninterrupted channel or waterway, without portages or inclined planes. If this was the case, since the use of temporary freshets was apparently impractical in the given situation, we must suppose that the designer, or some contemporary with whose idea he was familiar, had devised the hydraulic lock, anticipating in this by almost fourteen centuries the course of technical progress.

But, whether the method was to be by locks or by inclined planes, the Moselle-Saône canal scheme involved the application of a mechanical principle novel for the place and the time, and its abandonment may serve to illustrate in one way how indifference to engineering progress may have contributed to produce the ultimate economic stagnation of the Roman Empire.

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REVIEW

Greek Mercenary Soldiers From the Earliest Times to the Battle of Ipsus. By H. W. Parke. Oxford: At the Clarendon Press (1933). Pp. viii + 243. $3.75.

Like the study of literature, warfare, especially Greek and Roman warfare, is a subject that may be approached from many avenues. The military tactics and organization of the armies of ancient nations have been discussed by numerous authors, but there is still room for fresh treatments. The chief justification for the volume by Mr. H. W. Parke, Greek Mercenary Soldiers. . . ., is the fact that, as Mr. Parke points out[1], it was the mercenary soldier who became the professional soldier and thus made armies more efficient. It is convenient to be able to find in one volume a history of the influence of mercenaries upon Greek warfare.

This volume is the product of long, thorough, and painstaking study and investigation. One might suppose that a book on such a subject could be composed without much consultation of modern sources, but it is amazing how many modern works have been laid under tribute by Mr. Parke. It is no longer safe to use classical writers for historical or other purposes without being familiar with the critical literature that has grown up about them. Mr. Parke has spared no pains in familiarizing himself with the modern literature of his subject.

The volume is divided into six parts, as follows: First Part. From the Earliest Times to the End of the Peloponnesian War (3–19); Second Part. The Age of Cyrus II and Dionysius I (20–72); Third Part. The Age of the Mercenary Generals and the New Tyrants (73–112); Fourth Part. The Age of the Mercenary Adventurers and Philip of Macedon (113–176); Fifth Part. The Age of Alexander (177–205); Sixth Part. The Age of the Diadochi (206–238)[1a].

[1]See pages 1, 237.

[1a]I give more details about the contents of the book. The titles of the chapters are as follows (the semicolons mark the ends of the several Parts): I. Mercenaries on Service Abroad Before 500 B. C. (4–6), II. Mercenaries in the Service of the Early Greek Tyrants (7–13), III. Mercenaries in the Fifth Century Under the City-States (14–19); IV. Introductory to the Fourth Century (20–22), V. The Ten Thousand (23–42), VI. Greek Mercenaries Till the King's Peace (43–62: 1. In Spartan Service, 43–48, 2. In Athenian Service, 49–57, 3. In the East, 57–62), VII. Dionysius I (63–72); VIII. The Generals Themselves (73–75), IX. Greek Mercenaries Under the City-States Till Mantinea (76–96: 1. In Athenian Service, 76–83, 2. In Spartan Service, 83–90, 3. In Theban and Arcadian Service, 90–96), X. Other Tyrants and Autocrats (97–104), XI. Mercenaries in the East, 380–360 B. C. (105–112); XII. The Mercenary Adventurers (113–132: 1. Introduction, 113–114, 2. Dion, 114–122, 3. Mercenaries Under the Satraps, 122–125, 4. Charidemus of Oreus, 125–132), XIII. The Phoenician Tyrants (133–142), XIV. Mercenaries Under Athens Against Philip (143–154), XV. Mercenaries Under Philip of Macedon (155–164), XVI. Artaxerxes' Conquest of Egypt (165–169), XVII. Timoleon (170–176); XVIII. Greek Mercenaries in Persian Service, 340–330 B. C. (177–185), XIX. Mercenaries in Alexander's Army (186–198), XX. Anti-Macedonian Mercenaries, 333–322 B. C. (199–205: 1. Before Alexander's Death, 199–202, 2. After Alexander's Death, 202–

As might be expected, the use of mercenary forces brought changes in the art of war. One of the results of their use is well stated on page 236:

The specialized mercenary was less dependent than the citizen soldier on the mutual support of a mass of men. Hence fighting became more open, and this change reacted on the primitive hoplite phalanx. It was too cumbrous and unwieldy a body for its function in the new scheme of strategy. Chabrias and Iphicrates tried to evolve a substitute by producing a new form of peltast, who could wield a pike in massed formation, but could dispense with the heavy hoplite shield. It was on similar lines that Philip solved the problem by the new Macedonian phalanx.

Even in the Persian armies the Greek mercenaries were the dangerous soldiers, as Alexander recognized (181).

The citizen soldiers of Greece were accustomed to fighting in summer. The employment of mercenaries by Philip assured him a standing rather than a seasonal army, and hence he always had a disciplined force ready for instant action (159–160), and one with which he could work out modifications and innovations in the art of war.

The creation of a professional army does not account for all of the Macedonian success, but it did provide a medium in which a new spirit might operate[2]:

...This new spirit is not quite expressed as a change from the amateur to the professional, though that is in a sense true; it is not merely that, with the necessary qualifications, we almost feel as if we had passed from the ancient to the modern world, though that in a sense is also true. It was rather the intense earnestness and thoroughness which they brought to bear on the matter. They had no precedents, but they understood principles; if you had to fight, you fought for all you were worth, and with every sort of weapon, except one. They did *not*, as a rule, practise the things we call atrocities....

The use of mercenaries was a great aid to the Macedonians, but their employment was sometimes a symptom of the declining health of a nation. A state remains great only by the exercise of the virtues which created it[3]. Isocrates, after calling attention to the martial spirit and achievements of the Athenians, laments the deterioration of character which delegated military duties to vagabonds, deserters, and fugitives[4].

Personally I find most interesting the fourth and the fifth Parts of Mr. Parke's book. They have much to do with the armies of Philip and Alexander and of their successors. The final chapter, The General Circumstance <*sic!*> of Military Service (227–238), is very important; it would well repay reading by anyone who does not wish to take time for the entire book. It is an excellent survey of general conditions and considerations, and makes a fitting climax to the book.

I believe that there is one very plausible explanation for the increase in the number of mercenaries, in addition to the reasons well set forth by Mr. Parke in Chapter XXII. Greece seldom had prolonged respite from war (228). It is safe to say that after every long struggle there were many young men who had known no occupation but that of arms. The Greeks fought in summer, having, as one of their objects, the destruction of their enemies' crops. It must have been far easier for resourceless disbanded soldiers to seek service in foreign armies than to return home to put farms in condition to invite another attack.

There were always Greeks upon whom economic pressure bore heavily. Isocrates[5] tells us that lack of the necessities of life caused Greeks to enlist in foreign armies and to die fighting for the enemy against their friends. He says also[6] that the Greeks in Cyrus's army were not picked soldiers, but men who had found it difficult to make a living in their own cities. Xenophon[7], however, asserts that most of them were not in straitened circumstances, but it seems certain that he thought living conditions were better in Asia, for after the battle at Cunaxa he urged[8] his men to fight their way home and to tell the Greeks who were living in poverty that their plight was their own fault, since they could acquire wealth by conquest abroad. Isocrates[9] describes desperate bands, which, having no means of support, roamed from place to place and committed outrages. He advocated using them in a war of conquest against Persia and settling them in conquered territory. Exiles, too, greatly swelled the number of mercenaries[10].

Armies doubtless afforded a means of absorbing some of the surplus male population. That Attica had more inhabitants than it could support from its own produce is shown by the statement of Demosthenes[11] that the Athenians imported more wheat than other peoples imported.

There were adventurous Greeks who had run away from home to seek their fortunes under Cyrus the Younger[12]. The experiences of the Ten Thousand stirred the imagination of all Greece[13], and undoubtedly lured many to join the forces of Alexander.

Our own recruiting posters try to encourage enlistment by setting forth the opportunity that military or naval service gives to see the world. Enrollment in a foreign army gave restless young Greeks a chance to see something beyond the borders of their land[13a]. Doubtless the Greek desire to know the cities of many men and to learn their ways continued to be as pronounced in historic times as it was when Homer composed the opening lines of the Odyssey.

In spite of many difficulties and complexities the *subject* of this book is well presented, but, if it bore an American imprint, some of its infelicities in *language* would be characterized as 'trans-Atlantic'. The

205); XXI. Mercenaries in the Armies of the Diadochi (206–226: 1. Introduction, 206–209, 2. The Satraps' Armies Till 319 B. C., 209–211, 3. The Royal Armies Till 316 B. C., 211–215, 4. The Armies of the Separatists, 215–220, 5. The Armies of Some Minor Commanders, 220–223, 6. The Royal Armies of the Separate Monarchs, 223–226), XXII. The General Circumstance <*sic!*> of Mercenary Service (227–238). C. K.>.

[2]W. W. Tarn, Hellenistic Military and Naval Developments, 43–44 (Cambridge: At the University Press, 1930).

[3]Compare Sallust, Bellum Catilinae 2 Nam imperium facile iis artibus retinetur quibus initio partum est.

[4]De Pace 41–48. Compare Isocrates, Epistulae 9.9.

[5]Panegyricus 168. Compare Mr. Parke, 16, last paragraph.

[6]Panegyricus 146. [7]Anabasis 6.4.8. [8]Anabasis 3.2.26.

[9]Philip 120–123.

[10]*Ibidem*, 96. See Mr. Parke, 227–228, especially the references given at 227, note 1.

[11]Contra Leptinem 31. See Mr. Parke, 230.

[12]Xenophon, Anabasis 6.4.8.

[13]See, for example, Isocrates, Panegyricus 146–149, Philip 90–93.

<[13a]In my paper, Travel in Ancient Times as Seen in Plautus and Terence, Classical Philology 2 (1907), 1–24, 281–304, I discussed War Travel (see pages 281–283). C. K.>.

following sentence (103) seems to me to be neither smooth nor correct: "...But in actual fact the army was never used after he <Philip> became ταγός, and his mercenaries on only one occasion..." The phrase "with a fleet of forty triremes" is badly misplaced in this sentence (146): "...Proposals were made at once to repeat the achievement of 353 B. C. by sending out another citizen army of all those up to 45 years of age with a fleet of forty triremes..."

The word "so" begins sentences on an average of once in every four pages between pages 119 and 219, the only section of which I took a census. "But" is a not less frequent offender in this respect. In the upper half of page 220 it begins three sentences and one clause. "Also" and "already" are likewise too common as introductory words.

By the principle of self-determination our English cousins are justified in using 'only' before verbs in sentences in which we should place it elsewhere[14], but, after the 'trans-Atlantic' reader has found it in such a position in several scores of sentences, it is refreshing to encounter the following variation (182): "In Asia Minor Alexander had only a few remaining garrisons to reduce..."

The form of footnotes deserves just as much attention as the phrasing of the text, in fact, considerably more, because of traditional carelessness in regard to them and the danger of introducing ambiguities through the natural desire to secure brevity. Many footnotes in this book are entirely too much condensed for tidiness and even for clearness, as the following examples show[14a]:

Xen. *Hell.* VII. i. 25. Cf. for expeditions ibid. and D. S. XV. lxvii. 2, Xen. *Hell.* VII. iii. 1, under Aeneas of Stynphalus <*sic*!>, Lycomedes' successor, &c....

Also cf. Polyaen. v. ii. 7, which is worked up into a stratagem.

<Isocrates> viii. 24, cf. 44 seq., and *Ep.* ix. 9, about the same time.

Berve, No. 380: a young man at this time.

...For his earlier record cf. Plut. *Moral.* 192 A, 535 A, that he besieged Tromnus in spite of Archidamus, 364 B. C.....

The punctuation of both text and notes has received too little attention. The use of commas before restrictive clauses[15] does not make for clearness.

The book has two indexes: I. Employers and Commanders of Mercenary Soldiers (239–241) and II. Mercenary Generals and Soldiers (242–243). They are bare lists of names, with no suggestion of what the reader may expect to find in the text. A book prepared for the exclusive use of scholars should be provided with an index that gives an adequate idea of its contents. Obviously the brevity and the nature of the two indexes are due to a desire to save the author's time rather than the reader's.

This is an age of not many but countless books. The busy reader needs every bibliographical aid which an author can give him. If for the sake of saving space titles are both condensed and abbreviated, there ought to be a list of abbreviations. In fact, an author needs some such device as a safeguard for himself. In Mr. Parke's book, on page 46, in note 2 we have a reference to "...Tarn, *Hellenistic Military Developments*...", on page 214, in note 2 to "...Tarn, *Developments*..." The full title is Hellenistic Military and Naval Developments. The initials of the author's Christian names are W. W.

The final proof-reading was slighted. I feel sure that the author did not see the last proof. Most of the following errors glare at one: "Censoblertes" (144, note 3); "Stynphalus" (93, note 6); "mean tthat" (46, line 16); the comma at the end of the sentence (25, line 3); omission of grave accent in ἄν (130, note 1); omission of closing mark of parenthesis (150 <the parenthesis begins on line 17>, 163 <the parenthesis begins on the sixth line from the bottom of the text>); "this Speusippus' letter..." (157, note 1); "...I suppose the he died..." (151, note 3); "...Arrian's version, however, is clearly the most probably..." (179, note 6). The phrase "at his own expenses" seems to me to be incorrect, but it may be an Anglicism. The use of the two spellings Crimisus (174) and Cremisus (Table I, Column 6, bottom, at the end of the book) is more discreet than consistent.

There are several examples of failure to search for synonyms, as in "...Diodorus speaks throughout as if all Phalaecus' mercenaries accompanied him throughout..." (141).

Is "tendencious"[16] (29, line 2, 126, line 6, 141, line 3) a lapse or a liberty? Is Athenaeus really "*apt*[17] to be inaccurate in quotation..." (157, note 1)? What is there in the unsightly abbreviation "&c." (8, note 3, 93, note 6, 174, and elsewhere) which appeals to authors and presses? Why say "Agesilaus' do." and "Dercyllidas' do." (Table I, at the end of the book) and use "above" as a noun (199, note 5: "...The above seems a justifiable method of combining two defective traditions")?

Distressing experiences with my own papers and with manuscripts which come under my editorial supervision have forced me to the conclusion that small blemishes are all but inevitable. The only thing we can do is to use more and more care and caution in an effort to detect them before it is too late. Criticism of manuscripts by friends is a great aid, but he is a friend indeed who will take the time and the energy necessary to make detailed criticism of matters of form and style.

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[14]For example (171), "...Tauromenium could only provide the minimum sustenance for his soldiers..."

[14a]The passages quoted are to be found at 93, note 6; 118, note 1; 228, note 6; 183, note 1; 166, note 4.

[15]For examples see 154, line 4, "...But however it came about, Chaeronea summed up in practice the conflict, of which it was the conclusion..."; 156, line 2, "...But it had been remodelled so as to give the greater mobility and speedier power of attack, which up-to-date warfare required..."; 162, line 24, "...The third instance is in 348, when Philip adopted what was later a favourite practice—the loan of force to a friend, who would with its help set up in his native city a pro-Macedonian tyranny..."

[16]This spelling does not occur in the New English Dictionary.

[17]The italics are mine.

EURIPIDES, ALCESTIS 903-910

When Admetus returns from burying Alcestis, the Chorus endeavors to moderate his excessive grief. The leader tells of a kinsman who lost an only son, a promising and lovable lad, but did not give way to uncontrollable grief, though he was now childless and an old man. Commentators mention, usually with disapproval, the suggestion that here Euripides alludes to the death of a son of Anaxagoras. It is more likely that the poet had in mind Iliad 24.46–49, where Apollo says in his complaint against Achilles for the latter's excessive rage against Hector's body, caused by his grief for Patroclus, 'Many a man, I ween, has lost a loved one nearer and dearer <than Patroclus>, but such an one weeps and mourns and then has done, for the Fates have fashioned the heart of man to endure sorrow...' The two situations are very similar. The funerals of Alcestis and of Patroclus are over. The reason for an access rather than a diminution of grief is the same both for Admetus and for Achilles: each recognizes too late, Admetus at 939, Achilles at 18.102, that for the loss which has made life for him no longer worth living he alone is responsible. A debt like this cannot be paid with funeral rites.

It is perhaps more probable, however, that the reference to the loss of a son is a commonplace. Ajax, for example, uses it in commenting on the undue persistence of Achilles in his wrath against Agamemnon (Iliad 9.632–636).

UNIVERSITY OF VERMONT SAMUEL E. BASSETT

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